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BIOGRAPHY OF LEONID IVANOVICH SEDOV

- USSR -

by M. I. Gurevich

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BIOGRAPHY OF LEONID IVANOVICH SEDOV

- USSR -

/Following is a translation of portions of a Russian language brochure by M. I. Gurevich entitled Leonid Ivanovich Sedov, Moscow, Academy of Sciences USSR, 1959, pages 1-35; 44-48./

PRINCIPAL DATES IN THE LIFE AND ACTIVITY OF ACADEMICIAN L. I. SEDOV

Leonid Ivanovich Sedov was born on 14 November 1907 in Rostov-on-Don.

1924. Completed second division school (Rostov-on-Don).

-- Entered the Pedogogical Faculty of the North Caucasus University (Rostov-on-Don).

1925-1926. Laboratory assistant in the Physics Institute of the North Caucasus University.

1926. Entered the Physico-Mathematics Faculty of Moscow State University.

1927-1930. Laboratory assistant, physics teacher in the Workers' Faculty imeni Artem (Moscow).

1930. Graduated from the Physico-Mathematics Faculty of Moscow State University.

1930-1935. Instructor-lecturer, assistant professor, professor in the Moscow Aviation Institute imeni Sergo Ordzhonikidze.

1930-1947. Senior engineer, assistant chief of the laboratory of the Central Aero-Hydrodynamics Institute imeni N. Ye. Zhukovskiy (TsAGI).

1937 (to the present). Professor of the Moscow State University imeni M. V. Lomonosov.

1938. Accredited professor and doctor of physico-mathematical sciences by the Supreme Attestation Commission.

1938-1941. Chief of the Department of Theoretical Mechanics of the Military-Engineering Academy imeni V. V. Kuybyshev.

1943. Conferred the decoration "Badge of Honor" for work in TsAGI.

1945. Senior scientific associate of the Mathematics Institute of the Academy of Sciences of the USSR imeni V. A. Steklov.

-- Conferred the Order of Worker of the Red Banner for work in TsAGI.

1946. Chosen corresponding member of the Academy of Sciences of the USSR.

1947. Awarded the prize imeni S. A. Chaplygin by the Academy of Sciences of the USSR for the study "The Propagation of Intense Explosive Waves."

-- Assistant Chief of the Scientific Section of the Institute of Aircraft Engine Construction imeni P. I. Baranov.

1951 (to the present). Chairman of the Department of Hydromechanics of Moscow State University imeni M. V. Lomonosov.

1952. Director of the Mechanics Section and Chief Editor of the journal of abstracts for mechanics of the Institute of Scientific Information of the Academy of Sciences of the USSR.

-- Awarded a Stalin prize, second degree, for the monographs Ploskiye zadachi gidrodinamiki i aerodinamiki /Plane Problems of Hydrodynamics and Aerodynamics./ and Metody podobiya i razmernosti v mekhanike /Methods of Similitude and Dimension in Mechanics/, published in 1950 and 1951 (Izvestiya, 1952, 13/III, No. 62).

1953. Chosen an active member of the Academy of Sciences of the USSR.

-- Conferred the Order of Lenin for prolonged meritorious service and irreproachable work.

1953 (to the present). Chairman of the Department of Mechanics of the Mathematics Institute of the Academy of Sciences of the USSR.

1954. Member of the editorial board of the journal Doklady Akademii Nauk SSSR /Reports of the Academy of Sciences of the USSR/.

-- Awarded the first prize imeni M. V. Lomonosov for the study "The Application of Gas Dynamics to the Theory of Stellar Luminosity and to the Theory of Stellar Flare-Ups."

1954 (to the present). Chairman of the Standing Interdepartmental Commission on the Coordination and Control of Scientific-Theoretical Work in the Preparation and Execution of Interplanetary Communications.

1955. Leader of the Soviet delegation to the VI International Congress on Astronatuics (Copenhagen).

1956. Presented the paper "The Airflow of Profiles with High Supersonic Speed" at the International Conference on Rocket Technology (Freudenstadt, West Germany).

-- Presented the paper "On the Propagation of Explosive Waves in Media with Variable Density" at the VI Symposium on Combustion (New Haven, USA).

-- Presented the paper "On the Motion of Gas in Stellar Flare-Ups" at the IX International Congress on Mechanics (Brussels).

-- Chosen a member of the International Committee of the Congresses on Mechanics.

-- Leader of the Soviet delegation to the VII International Congress on Astronautics, where he was elected vice-president of the International Astronautical Federation (Rome).

-- Participated in the All-Union Contress of Mathematicians as a member of the Organizational Committee and Chairman of the Section on Mechanics; presented the paper "Methods of Similitude of the Nonlinear Mechanics of a Continum."

-- First Deputy Chairman of the National Committee of the USSR for Theoretical and Applied Mathematics.

1957. Leader of the Soviet delegation to the VIII International Congress on Astronautics, where he was elected vice-president of the International Astronautical Federation (Barcelona, Spain).

1958. Member of the editorial board of the journal Astronautica Acta, official organ of the International Astronautical Federation.

-- Leader of the Soviet delegation to the IX International Congress on Astronautics, where he was elected vice-president of the International Astronautical Federation (Amsterdam).

BRIEF SKETCH OF SEDOV'S SCIENTIFIC, PEDAGOGICAL, AND PUBLIC ACTIVITIES

Leonid Ivanovich Sedov was born to a family of engineers on 14 November 1907 in Rostov-on-Don.

After graduation from secondary school, L. I. Sedov entered the Pedagogical Faculty of the North Caucasus University. At the same time, he worked as a laboratory assistant in physics in the Physics Institute of the University. He entered the Physico-Mathematical Faculty of Moscow State University in 1926. Beginning in 1927, he worked as a laboratory assistant in physics simultaneously with his studies, and then as a teacher of physics in the Workers' School imeni Artem.

After his graduation from Moscow University (1930), Sedov began his scientific work in the Central Aero-Hydrodynamical Institute imeni N. Ye. Zhukovskiy (TsAGI). S. A. Chaplygin was at the head of theoretical scientific thought at that time. A whole pleiad of scientists, experimenters, and theoreticians worked with him there, including many students of N. Ye. Zhukovskiy.

TsAGI was the center of the Moscow aerodynamical school, which merited world fame. L. I. Sedov worked closely with S. A. Chaplygin, A. I. Nekrasov, M. A. Lavrent'yev, and M. V. Keldysh.

At the beginning of the 1930's, airplane and hydroglider design presented hydromechanics with difficult and interesting problems. One of the most pressing problems was research on the take-off and landing of hydroplanes. It was necessary to examine the nature of the forces acting on the hydrofoil, to derive calculating formulas, and to learn how to convert the results of testing models into actuality. It was also necessary to investigate the deleterious effects of the instability of planing, which sometimes led to hydroplane accidents, and to study the water impact which takes place on landing a hydroplane.

L. I. Sedov began his scientific activity with work on the last problem. He succeeded in obtaining valuable new results in his very first work. It is necessary to point out that, having worked out the afore-mentioned problem, Sedov soon became a scientist in his own right, who was able not only to resolve new problems but also to formulate them.

Sedov gave a mathematical formulation to the problems relating to the impact of a solid body floating on the surface of an incompressible fluid, in his articles "Impact of a Floating Wedge" (1935), "The Falling of a Wedge on a Water Surface" (1935), "On the Impact of a Solid Body Floating on the Surface of an Incompressible Fluid" (1934, 1935), and "An Outline of the Theory of Impact in Landing Hydroplanes" (1933). Using the method of the analytical continuation of harmonic functions, he showed that the problem of the impact of a floating body can always be reduced to Neyman's problem of a body symmetrical in relation to the surface of the unperturbed fluid level. In addition, the author determined the characteristics of the moments of fluid reaction and devised a theory of combined mass. In particular, the simplifications which take place in the case of plane problems were examined in detail and concrete problems were solved. One should take special note of the work "On the Impact of a Solid Body Floating on the Surface of an Incompressible Fluid," in which it was explained that with several impacts a separation of the liquid from the surface of the body will obligatorily occur. A complete solution to the problem of the sudden beginning of a movement in a horizontal direction of a vertical floating plate was also presented. In this case, the separation of the liquid occurs on the rear side of the plate.

Considerably later, Sedov published "Water Ricochets" a paper connected with the theory of impact, in which the principal facts and the laws of ricochet phenomena were, for the first time in writing, established on the basis of experimental analysis.

In the period from 1936 to 1941, a cycle of research embodying the fundamentals of the contemporary theory of planing was published by Sedov. Hydroplanes and seagliders move along the surface of the water at great speeds. The fundamental lifting force of the planing surfaces are created at the expense of the inertia of the particles of water which are thrust downward. Therefore one can disregard the hydrostatic lifting force in the first approximation and consider the fluid weightless. Since the angle of incidence of a planing surface is not great, the boundary conditions become linear. In addition, one can continue the flow in the upper half space, and the problem of the flow of a planing surface is changed to the problem of an airfoil. The analogy between a planing surface and a wing was discovered by G. Wagner in 1932. In the work entitled, Teoriya nestatsionarnogo glissirovaniya i dvizheniya kryla so sbegayushchimi vikhryami /The Theory of Unsteady Planing and the Motion of a Wing with Vortex Separation/ (1936), Sedov constructed mathematically a clear plane linearized theory of planing for unsteady motions and, in particular, he examined the oscillating motions of planing surfaces. This theory is analogous to the theory of a thin wing with a variable chord (the length of the chord is changed by changing the wetted surface of the planing plate).

It should be emphasized that the organic unification of the principles of hydrodynamics and aerodynamics was one of the reasons for the successes of the Moscow aerodynamic school, of which L. I. Sedov became an eminent representative. A detailed analysis of hydrodynamic forces and a classification of these forces according to their nature is presented in the work Teoriya nestatsionarnogo glissirovaniya i dvizheniya kryla so sbegaiyshchimi vikhryami mentioned above. The work of Sedov entitled, K zadacham o tonkikh poliplanakh tandem i o glissirovanii na neskol'kikh redanakh /On the Problems of Thin Tandem Multiplanes and of Planing on Several Redans/ (1937) is a direct continuation of this research. A solution to the problem of determining the turbulent motion of a fluid and the hydro- and aerodynamical forces acting on a multiplane composed of several thin, slightly surved plates arranged one after the other approximately in one line, which corresponds to technical problems, was presented in this work in a closed system. Closed formulas, presenting solutions in final form of integral, singular equations for the problem of a system of thin wings, were presented first in these two works.

Planing on the surface of a weightless fluid is the limiting case of planing in infinitely large Froude numbers. In the general case, one must not disregard the effect of gravity. Moreover, such important magnitudes as the wetted length of the planing plate and its lift in relation to an unperturbed fluid level cannot be calculated in general if the force of gravity is not taken into account. The solution to the problem of planing on the surface of a heavy fluid, however, is incomparably more difficult than the solution to the problem of planing on the surface of a weightless fluid. In particular, the analogy with the theory of a wing does not hold in planing on the surface of a heavy fluid. However complex the mathematical solution of the problem, it was nevertheless incomparably more difficult in its time to formulate it correctly, owing to the vagueness of the picture of the flow of the leading edge of a planing plate in the ambient. The problem of planing on the surface of a heavy fluid engendered heated discussions in the theoretical group of TsAGI. Several attempts were made to solve this problem, some proceeding from a physically incorrect formulation of the problem. In particular, the reasoning of G. Wagner and some other authors on the calculations of the force of the weight of water turned out to be incorrect.

The first to succeed in the correct formulation and to fully solve the two-dimensional problem of planing on the surface of a heavy fluid was L. I. Sedov.

Engineers who design seagliders and hydroplanes cannot limit themselves only to theoretical calculations and eschew experiments with models of seagliders and hydroplanes. On the other hand, the scientific formulation of experiments and the correct interpretation of experimental results with planing surfaces is impossible without an up-to-date theory of planing. In investigating the phenomenon of planing, experimenters were confronted with the fact that the planing condition of

vessels is determined by a large number of parameters. It then proved impossible to create all the calculated conditions with models of sea-gliders and hydroplanes in experimental basins. The methods of the theory of mechanical similarity which Sedov applied to the study of planing in the work O masshtabnom effekte i o naivygodneyshikh sootnosheniyakh pri glissirovanii /On the Scale Effect and Optimum Relations for Planing/ (1939, 1940) helped substantially in overcoming these difficulties.

The methods of dimensional analysis even proved exceptionally fruitful in studying the stability of planing. The article entitled "Planing over the Water Surface" (1940) initiated a series of investigations on the stability of planing. As a result of these investigations, the hydrodynamical nature of the forces which give rise to unstable motion was established; the means was found to recalculate the zone of stability by changing the load on the water, the planing speed, and the geometric scales; and, in addition, the character of the oscillating conditions on the boundaries of the zone of stability was clarified.

Sedov devoted the first 10 years of his scientific activity principally to the study of the phenomena of planing and water impact. Howwver, the circle of his interests was far from limited to these two problems. At the same time, he solved many fundamental problems concerning the theory of the plane flows of an ideal fluid.

His brochure entitled K teorii neustanovivshikhsya dvizheniy kryla v zhidkosti /On the Theory of the Unsteady Motion of an Airfoil in a Fluid/ (1935) was devoted to a systematic examination of problems of plane hydrodynamics, including an examination of the case where a point vortex system is found in a fluid. The author developed a general theory of unsteady motion with constant circulation on the basis of new formulas for calculating the hydro- and aerodynamic forces in the unsteady motions. These formulas, used for the motion of any deformed profiles, contain contour integrals from functions of a complex variable and can be regarded as a generalization of the well-known formulas of S. A. Chaplygin for steady motions. Moreover, effective formulas for the calculation of the combined masses of wings are presented in the brochure.

A solution to the problem of the motion of a fluid with constant circulations for grids composed of thin slightly-curved styluses in close proximity, adopted in the analysis of thin wings, is presented in the article entitled "On the Hydrodynamic Theory of Grids and Some Boundary Problems Leading to the Determination of Periodic Functions of a Complex Variable" (1938). In particular, the solution to the problem of the motion of a thin wing between two parallel walls or the problem of planing on the surface of a weightless fluid of finite depth, and, in addition, a solution to the problem of the impact of a number of plates on water of a finite depth are obtained from the general formula. A step forward in classical momentum theory was made by Sedov

in the study "The Development of the Zhukovskiy Method for Determining Streamlined Motions Constrained by Several Curvilinear Obstacles" (1938). In this work the problem of flow with the separation of jets by several obstacles was examined and the solution led to the establishment of an integral equation.

Practically useful results were obtained by Sedov also in the solution of the classical problem of the motion of a rotating body in an unlimited ideal incompressible fluid (O neustanovivshemsya dvizhenii vnutri zhidkosti tela vrashcheniya /On the Unsteady Motions of a Rotating Body in a Fluid/ 1940).

Apart from perfecting the statement of the general theory, supplemented by new considerations, the method of sources and flows, in the case of free rotating motions, is expounded in this book. An approximate solution to the hydrodynamic problem is presented for elongated cigar-shaped bodies. In addition, simple formulas for calculating the combined masses were determined.

In the joint work entitled Effektivnoye resheniye nekotorykh zadach dlya garmonicheskikh funktsiy /An Effective Solution to Some Problems of Harmonic Functions/(1937), M. V. Keldysh and L. I. Sedov presented an effective solution to the mixed problem of semiplanes and the problem of Neiman and Dirikhle for a double connected area--the appearance of a system of straight-line intercepts. These problems have direct application in hydrodynamics and the theory of elasticity; and the formula of Keldysh and Sedov is accordingly included in all monographs in which solutions to boundary problems of the theory of functions of complex variables are set forth.

Another article written jointly with M. V. Keldysh is entitled "The Theory of Wave Resistance in a Channel of Finite Depth" (1937). In this article the problem of the resistance of the Mitchell vessel in a channel of finite depth is solved.

One can clearly distinguish two principal lines, two fundamental methods, in the studies of L. I. Sedov. The diversity of subjects in his works is explained by the fact that after having created his methods, he subsequently expanded the areas of their application, using them to solve new classes of problems.

The first of these methods consists of the original use of the theory of functions of a complex variable to solve a broad class of problems of plane hydrodynamics of an ideal incompressible fluid. Sedov introduced an extremely opportune auxiliary functions which he designated g (z). In conjunction with the method of special points and the use of boundary integrals, the introduction of g (z) permitted him to effectively solve a number of problems. Part of them were solved earlier with great difficulty by individual approaches and part were solved first by Sedov. He later applied effective methods of the theory of functions of a complex variable even to the solution of plane problems of gas dynamics. The second group of methods developed by him were the similitude and dimension methods.

The monograph Teoriya ploskikh dvizheniy ideal'noy zhidkosti /The Theory of Two-Dimensional Motions of an Ideal Fluid/ (1939) is the result of Sedov's work on the theory of the plane flows of an ideal incompressible fluid. Part of this monograph served as the author's doctoral dissertation which was defended at Moscow State University in 1937.

The motion of a wing with constant circulation, the theory of a thin wing and grids, the impact on an incompressible fluid, momentum theory, and the flow into doubly connected areas are examined in six chapters. At the present time, this book is the most complete and precise account of the division of hydrodynamics dealing with plane flows of an incompressible, ideal, weightless fluid. The second edition of the book, which was significantly expanded, is discussed below.

Of all the theories which Sedov labored many years to formulate, dimension and similitude theory is especially noteworthy. He often brought the reasoning of this analysis into his studies on impact and planing, and they were among the important methods of investigation in the studies on scale effect (1940), planing stability (1940, 1941), and ricochets (1942).

The dimension and similitude theory permits a preliminary analysis of physical phenomena to be made even in those cases where, as a result of the complexity of the problem, a satisfactory mathematical scheme has not yet been created and equations of motion have not been formulated. It is impossible to correctly formulate and work out an experiment without the use of this theory.

The methods of dimensional analysis from the point of view of the calculations are very simple. However, this is merely seeming simplicity, since their application requires experience and a profound study of physical phenomena. There is one area of application of the theories in which a fine mathematical apparatus is used. It turns out that dimension and similitude analysis often helps find exact solutions to differential equations. The idea of this kind of use for similitude theory is that of Sedov ("On the Unsteady Motions of a Compressible Fluid," 1945). His great service lies in the fact that he systematically developed his idea in later works and with its aid obtained a number of valuable results.

At the time that Sedov applied dimensional analysis to planing and impact problems, the literature on dimension and similitude theory was in an unsatisfactory state. In textbooks, as a rule, the subject of similitude theory was touched upon only casually, in passing. With the exception of individual works, equally incorrect extreme opinions were dominant in the literature: on the one hand, the omnipotence of dimension and similitude theory; and, on the other, the triviality of the theory. Vague ideas on the essence of the very concept of dimensionality led to such extremes. T king account of all this, Sedov wrote and in 1944 published a monograph entitled Metody teorii razmernostey i teorii podobiya v mekhanike /Methods of Dimensional Theory and Similitude Theory in Mechanics./

The concept of physical similitude was introduced in the book in an exhaustive and quite simple form and the necessary and sufficient conditions for the similitude of two phenomena was set forth. Modeling methods were examined and a large number of examples of the use of similitude theory were analyzed in connection with which the formulations of new problems on water impact, ricochets, the stability of planing, etc., were presented. In addition, examples were given of the use of the reasoning of dimensional analysis for finding solutions to equations with partial derivatives by solving ordinary differential equations.

Considerable attention was given in the book to the elucidation of the fundamental concepts of dimension and similitude theory. Of the examples examined by the author, it is necessary to treat separately the study of isotropic turbulent motions of an incompressible fluid. This problem served as the subject of a special article (1944). Having studied the asymptotic laws of the decay of isotropic turbulence, taking account of third-order moments, Sedov demonstrated that the so-called Loitsianskii invariant on the assumption of the self-simulation of third-order moments is either zero or infinite or depends on time, since third-order moments diminish exactly as $1/r^4$.

The monograph Metody teorii razmernostey i teorii podobiya v mekhanike ran into four editions. In each edition the author inserted important additions in the form of accounts of new results obtained by him. We shall speak of these additions in greater detail later; but now we shall note only the study entitled "On the Theory of Shallow Waves on the Surface of an Incompressible Fluid" (1948) included in the second, third, and fourth editions of the book.

Considering the Cauchy-Poisson problem of waves on the surface of a heavy fluid, academician N. Ye. Kochin used the reasoning of dimension theory and gave the solution of this classical problem an elegant new mathematical form. Amplifying the reasoning of dimensional theory, Sedov found in explicity and simple form an entire class of new solutions to wave problems.

The velocities of the first airplanes were so low that in making aerodynamic calculations, the air could be considered an incompressible fluid. Even in the 1930's, however, the velocities of airplanes and propellers began quickly to approach the speed of sound and aerodynamics was confronted with the problem of considering the influence of compressibility. Soviet and foreign scientists remembered the outstanding work of S. A. Chaplygin entitled "On Gas Jets" /O gazovykh struyakh/ (1902) (see Materialy konferentsii po bol'shim skorostyam variatsii /Papers of the Conference on Great Speeds in Aviation/, Rome, 1933) and used the ideas contained in it as the basis for a whole series of studies on the motion of a body in gases. Whereas before this, works on the flows of compressible gases were extremely rare and represented a comparatively small part of aerodynamics in terms of volume, in the last 20 to 25 years the science of gas flows has developed into a most important independent division of hydromechanics--into gas dynamics.

Gas dynamics is the scientific basis for designing contemporary jet airplanes and missles, jet engines, tas turbines, compressors, and the like. In the study of gas flows at high velocities, the chemical and physical processes which take place at great temperatures must be borne in mind. Gas dynamics concerns itself with problems of combustion, explosion, and detonation, and quite recently, it found a new area of application--astrophysics.

Jet aviation appeared at the end of World War II and at once the urgent necessity for broad new gas-dynamic studies took form. In 1947 Sedov (already a corresponding member of the Academy of Sciences of the USSR at this time) transferred from the hydrodynamic laboratory of TsAGI to the laboratory of gas dynamics and later to the post of assistant chief of the scientific section of the Central Institute of Aircraft Engine Building imeni P. I. Baranov (TsIAM). Here he switched over almost completely to work on gas dynamics and in a short time became one of the leading scientists in this field. His first work on gas dynamics entitled "On Some Unsteady Motions of a Compressible Fluid" appeared in print in 1945. This article initiated a cycle of research devoted to one-dimensional motions of a gas with spherical, cylindrical, or plane waves. By the use of the reasoning of dimensional analysis for this class of problems, cases were successfully discovered where it proved possible to reduce equations of gas dynamics in partial derivatives to ordinary differential equations which allowed a series of important new exact solutions of equations of gas dynamics to be found.

The method proposed by Sedov proved extraordinarily fruitful; its possibilities even now are far from exhausted. Especially many results were obtained by the author and his close students. The first major achievement was a solution to the problem of an intense explosion and the propagation of intense shock waves (1946) on the assumption that only the instantaneously released energy of the explosion and the wave density have real significance. The entire solution to the problem wqs obtained in simple final form; laws were established for the drop in velocity of an expanding intense shock wave in cases of spherical, cylindrical, and plane waves. The velocity distribution, density, and pressure behind the front of a shock wave were also found. Sedov's discovery of the law of shock wave propagation proved to be in good agreement with the law of fire-ball propagation established by an atomic bomb explosion in New Mexico (1945). It is easy to reestablish this last law by working with frames of photographic film published by Taylor in 1953. For his study "The Propagation of Intense Explosive Waves" Sedov was awarded the prize imeni S. A. Chaplygin.

The second edition of the book Metody podobiya i razmernosti v mekhanike (1951) appeared in a significantly expanded form. Besides the solutions (with the aid of dimensional reasoning) of problems concerning waves of a heavy fluid and the motions of a viscous fluid, a new chapter appeared in this edition, "One Dimensional Unsteady Motions of a Gas." It contained an account of the work of the author and his close students. The general theory of the self-similar motions of a gas are presented in it; and the problems concerning the piston, implosion, and explosion of a gas at a point, detonation, combustion, the collapse of an arbitrary discontinuity in a combustible mixture, and, finally, the problem of an intense explosion are examined.

In 1954 the third edition of this book was printed. Chapter IV, entitled "One-Dimensional Unsteady Motions of Gases," was considerably expanded in this edition. In particular, the solution of the problem of an intense explosion, taking counterpressure into account and the solution of the problem of an intense explosion in a medium of variable density, were presented and the asymptotic laws of shock wave decay were studied.

Also substantially developed in this chapter was a general theory of one-dimensional gas flows, taking into account that to solve one-dimensional problems of gas dynamics in the absence of self-simulation, it is found necessary to apply numerical methods using contemporary computing machines.

Furthermore, a chapter entitled "Application to Astrophysical Problems" was added in which the results of a new direction in Sedov's work on one-dimensional gas dynamics were set forth. A part of these results were obtained by the author together with his students in carrying out the work of a seminar on hydromechanics at Moscow State University.

In studying the internal motion of stars and the evolution of stars and nebulae in astrophysics, models of phenomena have usually been created in the limits of the dynamics of systems of particles or in the limits of hydrostatics. Now, however, it has become clear that to study the fundamental problems of the internal structure of stars and to explain the grandiose phenomena observed in variable stars, it is necessary to use the methods, apparatus, and conceptions of modern gas dynamics.

A series of studies by Sedov, included in Chapter V of the third edition, are devoted to the application of the methods of gas dynamics and similitude and dimension methods to problems of astrophysics. The theory set forth in these studies presents rational new formulations of problems and exact solutions of equations of the adiabatic motions of gases and equations of gas equilibrium, taking Newtonian gravitational forces and radiation into account. In particular, several new results with regard to the theory of flare-ups of novae and the established formula for the laws "mass-luminosity" and "mass-radius" are set forth.

It should be noted that for the study "The Application of Gas Dynamics to the Theory of Stellar Luminosity and to the Theory of Stellar Flare-Ups" the author was awarded the first prize imeni M. V. Lomonosov (1954).

We cannot but pause on the new work of academician L. I. Sedov entitled "On the Dynamic Balanced Detonation" (1957), in which he succeeded in finding an excellent condition of a gas equilibrium capable of changing to an unsteady motion with a shock wave without the supply of external energy.

In 1957 the fourth edition of Metody podobiya i razmernosti v mekhanike appeared. The fourth edition was considerably reworked with regard to the method and supplemented by a number of new results relating in particular to the theory of the propagation of detonating waves in media with variable density.

Another of Sedov's principal monographs entitled Ploskiye zadachi gidrodinamiki i aerodinamiki /Plane Problems of Hydrodynamics and Aerodynamics/ appeared in a second edition in 1950. (The first edition of 1939 bore the title Teoriya ploskikh dvizheniy ideal'noy zhidkosti /Theory of Plane Motions of an Ideal Fluid/). Previous divisions of the work were materially broadened, in particular, the chapters devoted to the theory of grids and water impact. The additions to the theory of developed cavitational flows, made to the chapter "Theory of Jets" is considerable. (Although L. I. Sedov himself did not publish the studies on cavitation, he directly guided the elaboration of the theory of break-away cavitational flows which were carried out by his students.)

The theory of the plane flows of an incompressible fluid was supplemented by a new chapter entitled "Planing," the central feature of which is an account of the author's work, "Two-Dimensional Problem of Planing on the Surface of a Heavy Fluid," described above. Sedov's scientific interests in the second half of the 1940's were reflected in the last three chapters: "A General Theory of Steady Gas Flows," "Potential Steady Motions of a Gas," and "Gas Jets.

The methods of the theory of functions of complex variables (On which the account of the first seven chapters of the book are constructed) are used to good advantage in these concluding chapters of the monograph. However, the methods of the theory of nonlinear equations with partial derivatives of the second order play the fundamental role. Chapters VIII, IX, and X contain an original account of the basic problems of plane gas flows.

In the monograph a general theory of the motion of a compressible media is worked out, taking the possible complex physical or chemical processes (combustion, condensation, etc.) into account. General new equations of the motion of a compressible medium with the independent variables p and ψ (p = pressure; ψ = a function of the flow) are established, and on the basis of these equations a new class of exact solutions of equations of gas dynamics with the presence of vortices, shock waves, and with various entropies in the lines of flow are studied. New

theoretical methods for the study of the motions of a gas transiting the speed of sound were proposed in the monograph with the help of the generalization and material development of the approximation method of S. A. Chaplygin. These methods were published in 1949. New approaches to the contruction of continuous flows of profiles with the presence of circulation were developed in the theory of flows of profiles (Chapter IX) at great subsonic speeds.

Closely connected with Chapter IX is Sedov's theory of grids of profiles streamlined at subsonic speeds, which was not included in the book. Later on, he worked out this theory together with his students and the corresponding cycle of work appeared in a series of publications entitled, Sbornik statey po teoreticheskoy gidromekhaniki /Collected Articles on Theoretical Hydromechanics/ (1949, 1952-1954).

Several of Sedov's studies on gas dynamics have not appeared in any of his monographs. Of these, one should note first of all the article, "On the General Equation for the Kinetics of Chemical Reactions in Gases" (1948). His study on the flight efficiency factor of ram-jet engines (1954) and his work in collaboration with G. G. Chernyy on the averaging of gas flows have great practical value. In the article "Similarity Conditions and Abstract Parameters which Determine the Characteristics of Compressors" (1954), this practical important problem was clarified.

For his work in the field of hydromechanics and dimensional theory in mechanics, Sedov was conferred a Stalin prize, second order, in 1952.

During World War II, Sedov worked out a number of special problems and originated corresponding hydrodynamical theories.

Striving to formulate mechanical problems in such a way that he can successfully obtain a solution in an effective, simple, and closed form is Sedov's characteristic singularity. Such an approach to research and the general theories developed by him have served as a basis for discovering valuable regularities in his studies of phenomena, to which he has always attached great importance.

The significance of Sedov's studies in the field of hydromechanics is, however, not limited to the results obtained by him personally. Even in his first works, he devoted considerable attention to the formulation of new problems, acting not only as a mathematician creating new theoretical methods, but also as a scientist-naturalist. Carefully analyzing the results of experiments and not infrequently directly guiding an entire cycle of experimental work, Sedov advanced practical and theoretically important problems. Therefore many young scientists, working together with him or concurrently with him, have solved problems formulated by him, at times independently, having developed his ideas and methods. Add to this that he has never begrudged his time in working

with his associates and it becomes understandable that a strong scientific collective under his direction has rallied around him at TsAGI and later at Moscow University and TsIAM. Many of Sedov's students have become doctors and candidates of science. Of those working in TsAGI, one ought to mention in particular A. N. Vladimirov, M. I. Gurevich, R. L. Kreps, Ye. A. Fedorov, M. D. Khaskinda, M. G. Shcheglova, L. A. Epshteyn.

During World War II, Sedov began to direct the work of a seminar on hydrodynamics for graduate students in Moscow University. This seminar very quickly left the educational ranks and became a center for the scientific activity of the director and a number of students who later became illustrious scientists. Of these it is necessary to note G. M. Bam-Zelikovich, G. I. Barenblatt, I. O. Bezhayev, N. S. Burnova, G. Ya. Galin, S. S. Grigoryan, G. A. Doubrovskiy, V. P. Karlikov, V. P. Korobeynikov, Ya. M. Kotlyar, N. N. Kochin, Ye. A. Krasil'shchikova, N. L. Krasheninnikova, A. G. Kulikovskiy, M. L. Lidov, S. D. Maliuzhinets, M. P. Mikhaylova, N. N. Moiseyev, V. A. Prokof'yev, G. V. Rudnev, S. I. Sidorkina, G. F. Telenin, A. I. Utkin, G. G. Chernyy, D. A. Efros, S. L. Iukhvits, I. M. Yavorskiy, and Iu. L. Yakimov.

Reports on new studies in the most diverse fields of hydromechanics are made in the seminar; however, gas dynamics remains the basic subject. The most interesting original studies presented at the seminar are published in the form of special collections on theoretical hydromechanics. At the present time, seven issues of this publication have already appeared under the editorship of L. I. Sedov.

The systematic publication of a journal of abstracts for different branches of science began in the Academy of Sciences of the USSR in 1953. A prominent place in the organization of this important matter is held by Sedov, the chief editor of the journal of abstracts entitled Mekhanika [Mechanics].

Sedov has represented Soviet science many times at international conferences and is the first vice-chairman of the National Committee of the USSR for Theoretical and Applied Mechanics.

In conclusion, it is necessary to note the substantial pedagogical activity of Sedov as a professor of the Moscow Aviation Institute imeni Ordzhonikidze, and as professor and chairman of the Department Theoretical Mechanics in the Military-Engineering Academy imeni Kuybyshev. He has carried on considerable pedagogical work with the graduate students of Moscow University, TsAGI, TsIAM, and MAI [Moskovskiy Aviatsionny Institut -- Moscow Aviation Institute]. Since 1937, Sedov has been a professor and, later, chairman of the Department of Hydrodynamics in Moscow State University. The lectures delivered by him are always distinguished by their originality. The latest achievements in gas dynamics and hydrodynamics are reflected in these lectures. An especial service of Sedov is the introduction of thermodynamics into the course on hydromechanics. In addition to theoretical mechanics,

aeromechanics, hydromechanics, the introduction of a continuous medium into mechanics, and the special courses on gas machines, unsteady one-dimensional motions, and problems of plane hydrodynamics, Sedov has given various mathematical courses, among which should be noted a course on the equations of mathematical physics and a course on elliptical functions.

Professor, Doctor of Physico-Mathematical Sciences,
M. I. Gurevich

LITERATURE ON THE LIFE AND WORKS OF L. I. SEDOV

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Vestn. AN SSSR. Vestnik Akademii nauk SSSR. Moskva. [Herald of the Academy of Sciences of the USSR. Moscow.]

Vestn. MGU. Vestnik Moskovskogo gosudarstennogo universiteta. [Herald of Moscow State University.]

Vestn. MGU, Seriya fix.-mat. i est. nauk. Vestnik Moskovskogo gosudarstvennogo universiteta. Seriya fiziko-matematicheskikh i estestvennykh nauk. [Herald of Moscow State University. Series on the Physico-Mathematical and Natural Sciences.]

Dokl. AN SSSR. Doklady Akademii nauk SSSR. Moskva-Leningrad. [Reports of the Academy of Sciences of the USSR. Moscow-Leningrad.]

Izv. AN SSSR, OTN. Izvestiya Akademii nauk SSSR. Otdeleniye tekhnicheskikh nauk. Moskva. [News of the Academy of Sciences of the USSR. Division of Technical Sciences. Moscow.]

Izvestiya. Izvestiya Sovetov deputatov trudyashchikhsya SSSR. Moskva. [News of the Soviets of Workers' Deputies of the USSR. Moscow.]

Koms. pravda. Komsomol'skaya pravda. Moskva. [Komsomol Truth. Moscow.]

Kr. zvezda. Krasnaya zvezda. Moskva. [Red Star. Moscow.]

Lit. gaz. Literaturnaya gazeta. Moskva. [Literary Gazette. Moscow.]

Mezhdynar. polit. Mezhdynarodnaya politika. Belgrad. [International Politics. Belgrade.]

Mekhanika, Ref. zh. Referativnyy zhurnal. Mekhanika. Moskva. [Journal of Abstracts. Mechanics. Moscow.]

Nov. vremya. Novoye vremya. Moskva. [New Times. Moscow.]

Pravda. Pravda. Organ TsK KPSS. Moskva. [Truth. Organ of the Central Committee of the Communist Party of the Soviet Union. Moscow.]

Prikl. mat. i mekh. Prikladnaya matematika i mekhanika. Moskva. [Applied Mathematics and Mechanics. Moscow.]

Priroda. Priroda. Leningrad-Moskva. [Nature. Leningrad-Moscow.]

Prom.-ekon gaz. Promyshlenno-ekonomicheskaya gazeta. Moskva. [Industrial-Economic Gazette. Moscow.]

Slavyane. Slavyane. Moskva. [Slavs. Moscow.]

Sov. kn. Sovetskaya kniga. Moskva. [Soviet Book. Moscow.]

Sov. flot. Sovetskiy flot. Moskva. [Soviet Fleet. Moscow.]

Sudostroyeniye. Sudostroyeniye. Moskva. [Shipbuilding. Moscow.]

Tekhn. vozd. flota. Tekhnika vozdushnogo flota. Moskva. [Technology of the Air Force. Moscow.]

Tekhn. zametki TsAGI. Tekhnicheskiye zametki Tsentral'nogo Aerogidrodinamicheskogo institute. Moskva. [Technical Notes of the Central Aero-Hydrodynamical Institute. Moscow.]

Tr. TsAGI. Trudy Tsentral'nogo aerogidrodinamicheskogo instituta. Moskva. [Transactions of the Central AeroHydrodynamical Institute. Moscow.]

Usp. mat. nauk. Uspekhi matematicheskikh nauk. Moskva. [Advance of the Mathematical Sciences. Moscow.]

Uch. gaz. Uchitel'skaya gazeta. Moskva. [Teachers Newspaper. Moscow.]

Fiz.-mat. ref. zh. Fiziko-matematicheskiy referativnyy zhurnal. Moskva. [Physico-Mathematical Journal of Abstracts. Moscow.]

TsAGI. Tsentral'nyy aerogidrodinamicheskiy institut. Organ partkoma, TsB ITS, zavkoma, administratsii i avianito. Moskva. [Central Aero-Hydrodynamical Institute. Organ of the Communist Party Committee, Central Bureau of the Engineering and Technical Section, Factory Committee, Administration and All-Union Aviation, Scientific, Engineering and Technical Society. Moscow.]

Ents. sl., Entsiklopedicheskiy slovar'. Moskva. [Encyclopedic Dictionary. Moscow.]

C. R. Acad. Sci. URSS. Comptes rendus de l'Academie des sciences de l'URSS. Moscou. [Reports of the Academy of Sciences of the USSR. Moscow.]

Sowjetwiss. Naturwiss. abt. Sowjetwissenschaft. Naturwissenschaftliche Abteilung. Berling. [Soviet Science, Natural Sciences Division. Berlin.]

Vie nuove. Vie Nuove. Roma. [New Life. Rome.]

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